

Integrated Resource Plan

TVA's Environmental & Energy Future

Draft | October 2010 | Issue No. 1

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Summary

TVA is conducting a comprehensive study, known as the Integrated Resource Plan (IRP) – TVA's Environmental and Energy Future – to determine resource options for meeting the region's power needs and to help achieve environmental sustainability for the next 20 years. When completed in Spring 2011, the IRP will allow TVA to respond to a dynamic and evolving electric industry environment by providing a roadmap for the future. It will include resource options for meeting energy needs both on the supply side (such as conventional power plants) and the demand side (energy efficiency and peak demand reduction programs). The Draft of the IRP is now available for public comment through November 8.



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What is the IRP?

Electric utilities periodically develop integrated resource plans to help choose the most cost-effective way to meet the future needs of their customers. An IRP process evaluates the demand for power, options available to meet that demand, and the potential environmental, economic and operating effects of those options.

TVA last completed an Integrated Resource Plan in 1995, called Energy Vision 2020. The new IRP will reflect changes in regulations and legislation, the marketplace for electric generating utilities and customer demand.

The IRP will guide TVA in fulfilling the renewed vision adopted by the TVA Board in August 2010 – to become one of the nation’s leading providers of low-cost and cleaner energy by 2020.

TVA intends to lead the nation in improving air quality, lead the nation in increased nuclear production and lead the Southeast in increased energy efficiency.

That vision will be accomplished while TVA continues to fulfill the mission Congress established for TVA in the TVA Act. The IRP also will be consistent with TVA’s 2008 Environmental Policy as well as its 2007 Strategic Plan and will incorporate their goals.

TVA has prepared an Environmental Impact Statement (EIS) to address the potential impacts of alternative resource strategies. The associated draft EIS for the IRP is also available for public comment through November 8.



How is the public involved?

Public participation is an important part of TVA’s IRP process. The first step in the IRP process was a 60-day public scoping period in late Summer 2009. During this scoping period, TVA held seven public meetings in various locations around the region. About 200 people attended these public meetings, and about 40 people provided comments at the meetings. TVA received other comments by email and through the website created to provide IRP information and facilitate public input, www.tva.com/irp.

To help ensure stakeholder input throughout the development of the Draft IRP, TVA formed a Stakeholder Review Group made up of 16 individuals representing a range of interests. The Stakeholder Review Group has met 10 times to discuss and respond to TVA’s process, assumptions, analyses and results. In addition, TVA has held quarterly public briefings and has conducted both written and telephone surveys.

TVA will hold four additional public meetings to gain input on the Draft IRP.

- **October 5, 6–8 p.m. CST** – Bowling Green, KY
Holiday Inn and Conference Center
- **October 7, 6–8 p.m. CST** – Olive Branch, MS
Whispering Woods Conference Center
- **October 13, 6–8 p.m. EST** – Knoxville, TN
TVA West Tower Auditorium
- **October 14, 6–8 p.m. CST** – Huntsville, AL
Marriott Space Center

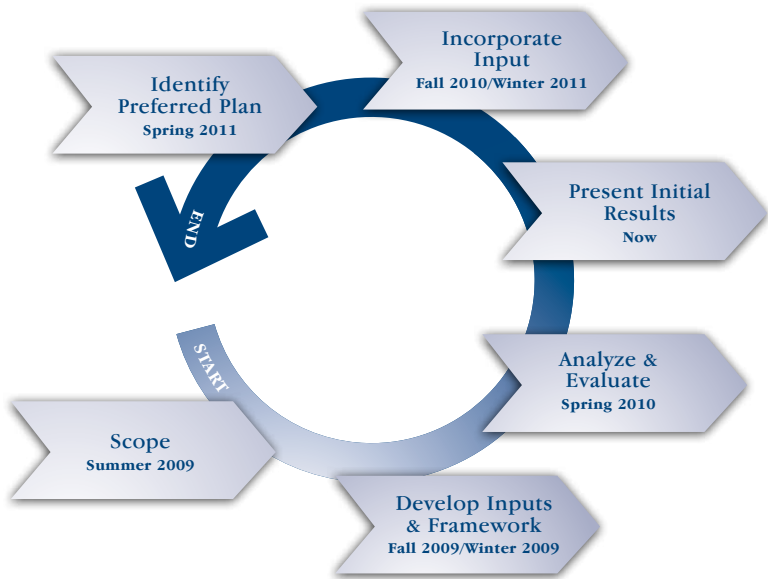
Each of these meetings also can be viewed via webinar. Instructions on attending the webinars will be available at www.tva.com/irp. The public is encouraged to send in comments on the Draft IRP via the IRP website.

What is the IRP process?

TVA follows six basic steps in creating the IRP.

- 1) Develop a forecast of the power needed over the next 20 years.
- 2) Develop scenarios that represent the possible “worlds” TVA may encounter in the future.
- 3) Develop strategies to address those worlds.
- 4) Analyze each planning strategy in each of the different scenarios to create a matrix of portfolio options TVA should consider. Each portfolio represents a possible 20-year power supply plan that describes how a strategy performs under a variety of future scenario conditions.
- 5) Rate the strategies using a scorecard designed to identify financial, risk and strategic factors that should be considered when selecting a preferred planning strategy.
- 6) Identify a preferred strategy.

TVA Integrated Resource Planning Process



How does TVA determine how much power will be needed in the future?

As part of the IRP analysis, TVA must forecast how much power will be needed to serve customers in the future. Having an accurate forecast is critical. If TVA’s forecast is inaccurate, it could end up building new power plants that are not needed. On the other hand, it could also mean there is not enough power available to meet customer demand. TVA examines the expected changes in the economy and relies on sophisticated forecasting tools to help determine what consumers may need in the future. This is a process that TVA performs regularly, not just as part of the IRP; and recent forecasts have been very accurate at predicting how much power is actually used in the region.

TVA also must identify the existing resources available to meet the demand – existing power plants, energy efficiency and demand response programs, and purchases from the market. Then TVA must compare the available resources with the expected future demand. The difference between the two, along with a reserve margin, becomes the additional resources needed, or the “capacity gap.”



How does TVA decide on the best plan for meeting future energy needs?

To meet the anticipated need for power in the future, TVA has reviewed resource options that are currently, or are expected to be, commercially available by 2029. These resources include coal-fired generation, natural gas-fired generation, nuclear generation, renewable generation – including hydroelectric, wind, solar and biomass – and energy efficiency and demand response programs.

Planning for customer needs requires a planning strategy that is robust regardless of what happens in the future. The IRP addresses the uncertainty of the future through a scenario planning methodology.

- Analysis is a four step process:
- 1) Develop Scenarios
 - 2) Develop Strategies
 - 3) Construct Portfolios
 - 4) Analyze Results

IRP scenarios

First, TVA developed various scenarios based on a number of factors that are outside of TVA's control. The scenarios don't attempt to predict the future; they only describe future uncertainties that TVA should be prepared for – those that could potentially have the biggest impact on TVA. Examples of the uncertainties that make up the scenarios include economic growth, construction costs, fuel prices and the regulatory environment.

Six unique scenarios were developed for the IRP, in addition to the current TVA forecast or “baseline:”

- **Scenario #1:** Economy Recovers Dramatically
- **Scenario #2:** Environmental Focus is National Priority
- **Scenario #3:** Prolonged Economic Malaise
- **Scenario #4:** Game-Changing Technology
- **Scenario #5:** Energy Independence
- **Scenario #6:** Carbon Regulation Creates Economic Downturn

Descriptions of each scenario can be found at www.tva.com/irp.

Scenario	Key Characteristics
<div>1</div> Economy Recovers Dramatically	<ul style="list-style-type: none">• Economy recovers stronger than expected and creates high demand for electricity• Carbon legislation and renewable electricity standards are passed• Demand for commodity and construction resources increases• Electricity prices are moderated by increased gas supply
<div>2</div> Environmental Focus is a National Priority	<ul style="list-style-type: none">• Mitigation of climate change effects and development of a “green economy” is a priority• The cost of CO₂ allowances, gas and electricity increase significantly• Industry focus turns to nuclear, renewables, conservation and gas to meet demand
<div>3</div> Prolonged Economic Malaise	<ul style="list-style-type: none">• Prolonged, stagnant economy results in low to negative load growth and delayed expansion of new generation• Federal climate change legislation is delayed due to concerns of adding further pressure to the economy
<div>4</div> Game-changing Technology	<ul style="list-style-type: none">• Strong economy with high demand for electricity and commodities• High price levels and concerns about the environment incentivize conservation• Game-changing technology results in an abrupt decrease in load served after strong growth
<div>5</div> Reduce Dependence on Foreign Energy Sources	<ul style="list-style-type: none">• The U.S. focuses on reducing its dependence on non-North American fuel sources• Supply of natural gas is constrained and prices for gas and electricity rise• Energy efficiency and renewable energy move to the forefronts as an objective of achieving energy independence

IRP planning strategies

The next step in TVA's IRP process has been the development of various planning strategies that TVA could use to meet the region's power needs under those scenarios. Unlike scenarios, planning strategies are within TVA's control. Planning strategies are designed to test various business options (approaches) TVA might consider, like whether or not to pursue additional nuclear plants, or invest in more energy efficiency, or choose to idle some aging coal units. The five specific planning strategies considered in the IRP draft are:

- **Strategy A:** Limited Change in Current Resource Portfolio
- **Strategy B:** Baseline Resource Portfolio
- **Strategy C:** Diversity Focused Resource Portfolio
- **Strategy D:** Nuclear Focused Resource Portfolio
- **Strategy E:** Energy Efficiency/Demand Response and Renewables Focused Resource Portfolio

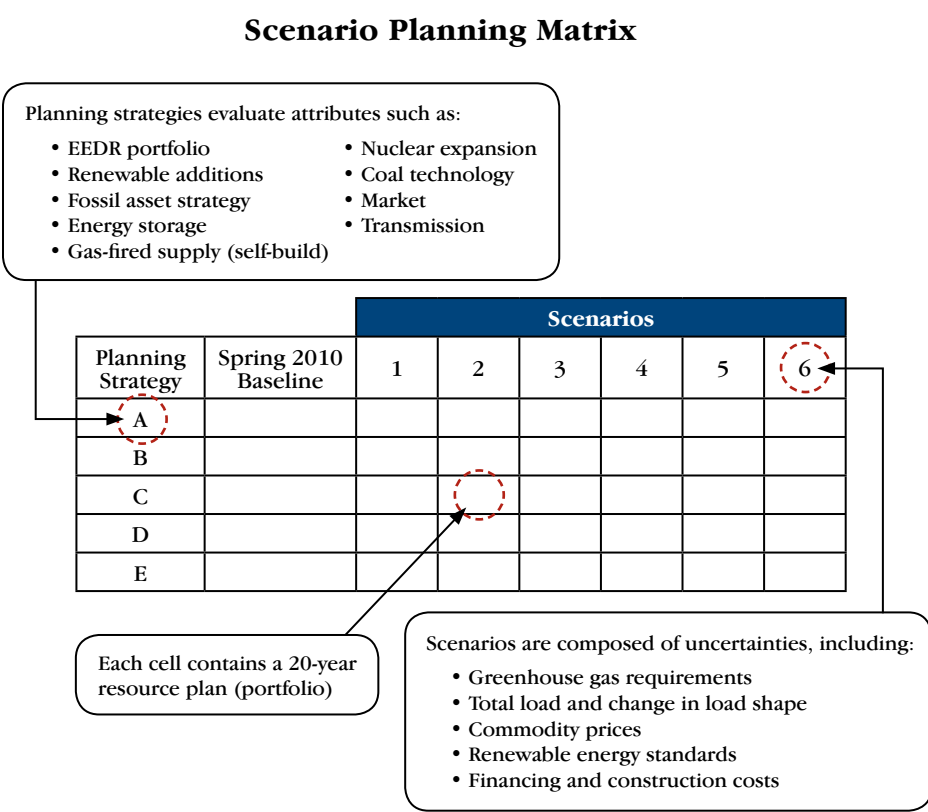
More detailed information on the strategies can be found at www.tva.com/irp.

Planning Strategy	Key Characteristics
<div>A</div> Limited Change in Current Resource Portfolio	<ul style="list-style-type: none">• Retain and maintain existing generating fleet (no additions beyond Watts Bar 2)• Rely on the market to meet future resource needs
<div>B</div> Baseline Plan Resource Portfolio	<ul style="list-style-type: none">• Allows for nuclear expansion after 2018 and new gas-fired capacity as needed• Assumes idling of 2000 MW of coal capacity• Includes EEDR portfolios and wind PPA's
<div>C</div> Diversity Focused Resource Portfolio	<ul style="list-style-type: none">• Allows for nuclear expansion after 2018 and new gas-fired capacity as needed• Increases the contribution from EEDR portfolio and new renewables• Adds a pumped-storage hydro unit• Assumes idling of 3000 MW of coal capacity
<div>D</div> Nuclear Focused Resource Portfolio	<ul style="list-style-type: none">• Allows for nuclear expansion after 2018 and new gas-fired capacity as needed• Includes an increased EEDR portfolio compared to other strategies• Assumes idling of 7000 MW of coal capacity• Includes new renewables (same as planning Strategy C)• Includes a pumped-storage hydro unit
<div>E</div> EEDR and Renewables Focused Resource Portfolio	<ul style="list-style-type: none">• Assumes greatest reliance on EEDR portfolio of any strategy and includes largest new renewable portfolio• Assumes idling of 5000 MW of coal capacity• Delays nuclear expansion until 2022

IRP portfolios

The five planning strategies are analyzed in each of the seven scenarios to create a matrix of 35 portfolios (20 year plans) for TVA to consider. Each portfolio describes how a strategy performs under a certain scenario.

The 35 portfolios are then run through a computer model that tests the performance of each portfolio across 13 different variables such as gas and coal prices, interest rates, O&M and capital costs, power plant availability and carbon dioxide (CO₂), sulfur dioxide (SO₂) and nitrous oxides (NO_x) allowance prices. More than 2000 possible cases have been tested.



IRP scorecards

Finally, the portfolios are evaluated using a scorecard designed to identify financial, risk and strategic factors that should be considered when selecting a preferred planning strategy.

The Draft IRP scorecard consists of two sections – ranking metrics and strategic metrics. The ranking metrics are financial measures of cost and risk, which are the types of metrics most utilities use when evaluating strategies. TVA’s mission is broader than that of most utilities, and as such, it must evaluate how various strategies would affect its other roles. The strategic metrics consist of environmental stewardship and regional economic impacts. TVA did not assign a metric to technology innovation, which is another key element in its overall mission, but it will be included as background information for each strategy.

The results of the portfolio ranking metrics scores are shown here in color coded tables, where the best values are coded green, and the worst are coded red. Portfolios are scored; strategies are ranked.

The strategic metric scores are shown using the Harvey Ball system, where the rank order among the strategies is indicated by the amount of the ball that is filled in (the more of the ball that is filled in, the better).

Strategic Metrics for Five Planning Strategies

Planning Strategy A

Strategic Metrics					
Environmental Stewardship			Economic Impact		
Scenarios	CO ₂ Footprint	Water	Waste	Total Employment	Growth in Personal Income
1	○	◐	◐	0.1%	0.1%
2	○	◐	◐		
3	○	○	○		
4	○	◐	◐		
5	○	◐	◐		
6	○	○	◐	-0.4%	-0.4%
Baseline	○	◐	◐		

Legend

●	Better
◐	↑
◑	
○	

Planning Strategy B

Strategic Metrics					
Environmental Stewardship			Economic Impact		
Scenarios	CO ₂ Footprint	Water	Waste	Total Employment	Growth in Personal Income
1	◐	○	○	1.0%	0.8%
2	◐	○	○		
3	◐	◐	◐		
4	◐	○	○		
5	◐	○	○		
6	◐	◐	○	-0.3%	-0.3%
Baseline	◐	○	○		

Planning Strategy C

Strategic Metrics					
Environmental Stewardship			Economic Impact		
Scenarios	CO ₂ Footprint	Water	Waste	Total Employment	Growth in Personal Income
1	◐	◐	◐	0.9%	0.6%
2	◐	◐	◐		
3	◐	◐	◐		
4	◐	◐	◐		
5	◐	◐	◐		
6	◐	◐	◐	0.2%	0.1%
Baseline	◐	◐	◐		

Planning Strategy D

Strategic Metrics					
Environmental Stewardship			Economic Impact		
Scenarios	CO ₂ Footprint	Water	Waste	Total Employment	Growth in Personal Income
1	●	◐	●	1.2%	1.0%
2	●	◐	●		
3	●	●	●		
4	●	◐	●		
5	●	●	●		
6	◐	●	●	-0.1%	-0.2%
Baseline	●	●	●		

Planning Strategy E

Strategic Metrics					
Environmental Stewardship			Economic Impact		
Scenarios	CO ₂ Footprint	Water	Waste	Total Employment	Growth in Personal Income
1	◐	●	◐	0.8%	0.6%
2	◐	●	◐		
3	◐	◐	◐		
4	◐	●	◐		
5	◐	◐	◐		
6	●	◐	◐	0.3%	0.2%
Baseline	◐	◐	◐		

Planning Strategy A – Limited Change in Current Resource Portfolio

Ranking Metrics					
Scenarios	PVRR	Short-Term Rate Impact	Risk/Benefit	Risk	Ranking Metric Score
1	93.87	100.00	95.07	91.26	94.82
2	95.76	99.25	90.32	85.74	93.61
3	98.28	95.78	98.39	94.38	96.84
4	97.49	100.00	88.75	77.41	92.42
5	97.09	99.85	91.73	87.21	94.81
6	94.14	93.66	90.08	80.82	90.51
Baseline	96.74	100.00	90.59	85.43	94.15
Total Ranking Metric Score:					657.15

Total Ranking Metric Score=Sum of Ranking Metrics Scores for all seven scenarios

Ranking Metric Score=65%*(65%*PVRR + 35%*ST Rate) + 35%*(35%*Risk/Benefit + 65%*Risk)
=65%*(65%*97.09 + 35%*99.85) + 35%*(35%*91.73 + 65%*87.21)=94.81

Planning Strategy B – Baseline Plan Resource Portfolio

Ranking Metrics					
Scenarios	PVRR	Short-Term Rate Impact	Risk/Benefit	Risk	Total Plan Score
1	97.71	97.59	98.40	97.34	97.68
2	97.76	98.85	100.00	99.98	98.79
3	99.61	98.70	91.37	83.79	94.79
4	98.38	98.11	98.25	93.79	97.26
5	98.44	98.14	98.61	98.94	98.51
6	96.55	96.96	88.56	78.46	91.55
Baseline	98.01	99.01	96.50	94.26	97.20
Total Ranking Metric Score:					675.78

Planning Strategy C – Diversity Focused Resource Portfolio

Ranking Metrics					
Scenarios	PVRR	Short-Term Rate Impact	Risk/Benefit	Risk	Total Plan Score
1	100.00	97.48	100.00	100.00	99.43
2	99.58	100.00	96.20	96.17	98.49
3	100.00	97.13	100.00	100.00	99.35
4	100.00	97.94	100.00	100.00	99.53
5	100.00	100.00	100.00	100.00	100.00
6	98.59	96.09	98.19	93.22	96.75
Baseline	100.00	98.71	100.00	100.00	99.71
Total Ranking Metric Score:					693.25

Planning Strategy D – Nuclear Focused Resource Portfolio

Ranking Metrics					
Scenarios	PVRR	Short-Term Rate Impact	Risk/Benefit	Risk	Total Plan Score
1	97.40	97.54	96.41	96.81	97.18
2	97.90	98.51	99.04	98.90	98.40
3	99.41	100.00	81.31	69.12	90.43
4	97.40	97.97	90.14	92.05	95.42
5	97.86	98.47	96.57	92.60	96.64
6	100.00	100.00	89.16	78.46	93.77
Baseline	98.56	99.79	92.15	91.33	96.41
Total Ranking Metric Score:					668.26

Planning Strategy E – EEDR and Renewables Focused Resource Portfolio

Ranking Metrics					
Scenarios	PVRR	Short-Term Rate Impact	Risk/Benefit	Risk	Total Plan Score
1	99.43	99.21	97.82	96.78	98.58
2	100.00	99.22	99.79	100.00	99.80
3	99.15	96.03	95.91	97.73	97.72
4	99.45	99.58	95.32	89.57	96.73
5	99.83	99.50	98.87	99.47	99.56
6	99.16	95.61	100.00	100.00	98.64
Baseline	99.68	99.77	98.98	98.96	99.45
Total Ranking Metric Score:					690.47

Legend

●	Better
◐	↑
◑	
○	

Emerging theme and scope

Each of the seven scenarios results in a different forecast of future power needs and thus a different capacity shortfall for the TVA power system. The range of capacity gaps over the 20-year planning horizon is quite broad – from a low of no additional capacity needed to a high of about 20,000 megawatts. The planning strategies determine which types of resources would be used to meet the capacity gaps.

The following key themes have emerged in the top ranking strategies in the Draft IRP:

- Nuclear expansion is present in a majority of portfolios.
 - The first nuclear unit is added between 2018 and 2022.
 - Nuclear overtakes coal as the leading source of energy.
- The idling of a portion of TVA's fossil capacity is indicated in most portfolios, ranging from 2,000 MW to 5,000 MW of coal-fired capacity.
- Energy efficiency and demand response, as well as renewable generation, play an increasing role in future resource portfolios.
- Natural gas capacity additions are a viable resource option and a key source of flexibility for TVA.
- The intensity of CO₂, NO_x, SO₂ and mercury emissions (measured in terms of per unit of energy produced) decreases in all portfolios.

The ranking of the strategies contained in the draft suggest that Planning Strategy C – diversity focused resource portfolio – and Planning Strategy E – energy efficiency/demand response and renewable focused resource portfolio – perform best relative to the other planning strategies.

Planning Strategy B which represents a “business as usual” approach also performs relatively well. It is retained for further analysis and is the “no action alternative” required as part of the EIS.

Based on these rankings, TVA will remove Planning Strategies A and D from further consideration. TVA will continue to evaluate the attributes of Planning Strategies C, E and B between the draft and final IRP.

Considering multiple planning strategies ensures that TVA will test a broad range of resource options, including from zero

to 4,800 megawatts of nuclear, zero to 7,500 megawatts of combustion turbines and 1,400 to 6,000 megawatts of energy efficiency and demand response.

Range of Capacity Additions (MW)^{1,2,3}

Type	Existing System	Minimum	Maximum
Nuclear	7,800	0	4,800
Combustion Turbine	5,300	0	7,500
Combined Cycle	2,200	0	5,700
IGCC ⁴	0	0	500
Avoided Capacity (EEDR)	346	1,400	6,000
Renewables	150	150	1,200
Pumped-storage	1,600	0	850
Coal Units Idled	0	0	4,700
Conventional Coal	13,300	0	0

Notes:

1 – Capacity values are expressed in terms of summer dependable capacity

2 – Ranges represent the maximum and minimum values for each type and are not from a single portfolio. Energy values are shown in 2025

3 – Excludes capacity and energy additions from approved projects (Watts Bar Nuclear Unit 2, John Sevier Combined Cycle, and Lagoon Creek Combined Cycle)

4 – Integrated Gasification Combined Cycle

What happens next?

Concurrent with the public comment period that is now underway on the Draft IRP/EIS, sensitivity analyses will be applied to the top ranking planning strategies between the release of the Draft and Final IRP to see if certain changes can further improve the cost and ranking of one or more strategy. New, refined planning strategies will likely evolve from this process for final consideration.

TVA will review all public comments, modify its sensitivity analyses as appropriate and finalize the IRP/EIS following the conclusion of the public comment period November 8.

The Final IRP and EIS will be completed and submitted to the TVA Board in Spring 2011.

Building on the demonstrated value of this IRP's approach, it is anticipated that TVA will begin the next IRP effort by 2015.

The complete Draft IRP, Draft EIS and supporting appendices can be found at www.tva.com/irp. TVA also welcomes comments and questions on the Draft IRP and Draft EIS via the IRP website, www.tva.com/irp.